Keys to the genera of Mesembryanthema

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A key to the two subfamilies comprising the Mesembryanthema is given. Keys to the genera in each subfamily are provided (9 genera in Mesembryanthemoideae, 107 in Ruschioideae). Two keys are presented for the Ruschioideae, based on fruit and vegetative characters respectively.

'n Sleutel tot die twee subfamilies van Mesembryanthema, asook tot die genera van elk van die subfamilies (9 genera tot Mesembryanthemoideae en 107 tot Ruschioideae) word gegee. Twee sleutels tot Ruschioideae word verskaf: die een is op die kenmerke van die vrugte en die ander op vegetatiewe kenmerke gebaseer.

Keywords: Aizoaceae, fruit, growth form

Introduction

Dating from pre-Linnaean times, flower characters have been considered to be of the highest importance in delimiting most families of flowering plants; the division of the angiosperms is mainly based on these characters which are in general assessed to be more constant than other features. In contrast to this, fruit characters have mainly been used in establishing the genera separated from the old genus *Mesembryanthemum* (introduced and discussed by Brown 1921). As a consequence, most of the 116 genera recognized at present can be identified with the help of fruit characters, but only some by vegetative characters. Yet, for the large subfamily Ruschioideae two different keys are provided, but the user will soon realize that characters from other parts of the plants will be needed as well.

Genera have been seen as rather stable units in Mesembryanthema in the past, but recent results reveal that neither the delimitation of characters, nor the circumscription of species, are so well founded that the traditional boundaries can be retained (e.g. in *Eberlanzia*). It has not yet been possible to revise all genera down to species level in order to arrive at well-considered circumscriptions, nor was it possible to publish all known results. This is particularly trying in several large genera (e.g. *Delosperma*) of wide distribution which are mostly visualized in accordance with some 'typical' species. It should be remembered that deviating forms occur, and that delimitations of several of these genera have been altered. As a consequence, the user of the keys will in some cases arrive at what appears to be the wrong genus (e.g. in species of the genera *Ruschia, Octopoma* and *Eberlanzia*) because the recently established genus circumscriptions adopted here do not necessarily agree with past usage. These new genus delimitations will be published before long.

Material

Extensive field work over 21 years forms the base of this contribution, and more than 7 000 collections have been analysed for about 220 characters each. Nevertheless, not every species has been studied in detail, and any additional information will be welcome. Particularly in widespread genera not yet investigated fully, e.g. *Lampranthus, Drosanthemum* and *Delosperma*, which are grown widely in cultvation, more material of known wild origin will have to be seen and incorporated into the keys. Therefore, the proposed keys are working keys published to be tested, and they are open for appropriate amendments and additions.

Characters

Of all characters examined, only the ones useful for distinguishing genera have been used in the construction of the keys.

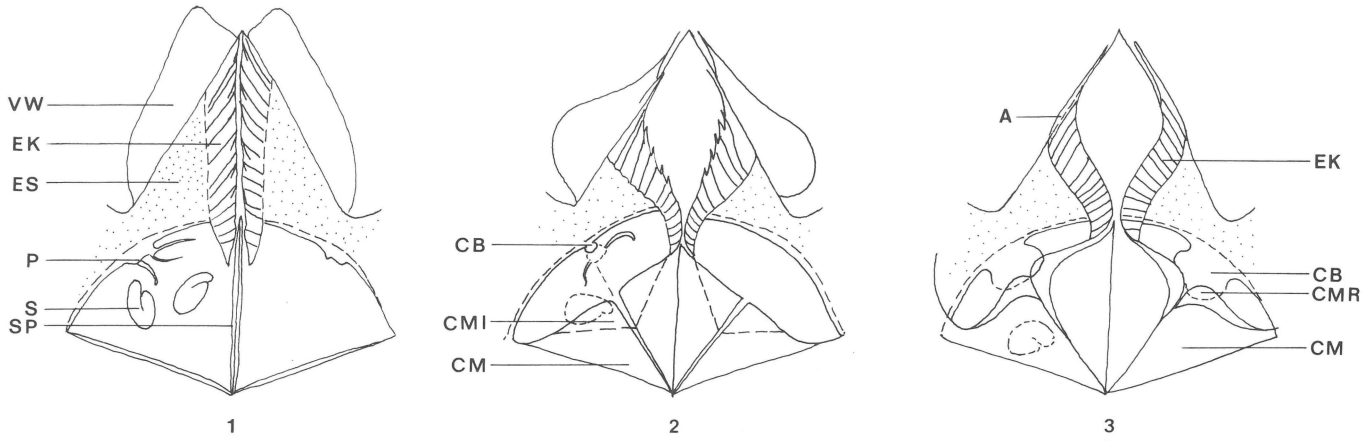
Material has been examined in the fresh state in the field, for vegetative and floral characters, but some characters have been established from greenhouse material. Fruits have been used in the dry state, because these are available for most of the year, and because their characters have been found to be most reliable. The keys are most successfully used on material in habitat during the dry season; herbarium material is difficult to identify. Functional fruits must be chosen and allowed to open by imbibition in water. Specimens with flowers only are extremely problematic because the basic delimitation of genera is only very rarely based on floral characters (e.g. *Argyroderma, Erepsia*). Furthermore certain floral characters that could well be used (e.g. nectaries) are not preserved during the drying process.

Since fruit characters used for the delimitation of genera are very specialized in the group, users should be familiar with the terminology. Comprehensive definitions of terms can be found elsewhere (Hartmann 1983, 1988), and only some essential information is given here (Figures 1–6).

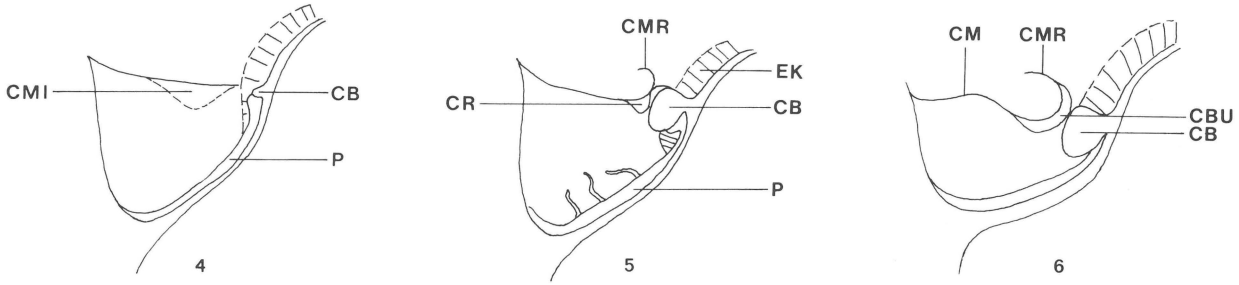
Keys

Although I have tried to use only pairs of completely contrasting character states, some contrasts will appear ambiguous. It is advisable to follow both alternatives until a clear contradiction is found along one path — the other should then work out.

Dispersal is tardy in Mesembryanthema, and several features collaborate to keep the seeds inside the locule. Closing bodies are in most cases derived from the outer capsule wall (CB in Figures 2, 3, 5 & 6); large closing



Figures 1–3 Views of segments of open fruits showing one valve in the upper centre and two locules; the combinations of character states as shown are possible, but they do not necessarily occur together. **1.** Locules open, the septa possess only very narrow marginal rims (SP), the seeds are visible; expanding keels (EK) lie strictly radially, i.e. exactly on the radius; broad valve wings (VW) of ± rectangular shape. **2.** Locules with covering membranes (CM), along the broken line, in some forms, a part can inflex after the seeds have been removed; tiny endocarpal closing body (CB); expanding keels diverge widely; valve wings are basally very broad and taper towards the tip of the valve. **3.** Locules with firm resilient covering membranes of constant shape, distally recurved (CMR) ± reaching the large closing body thus blocking the distal opening of the locule ± completely. A: awn in place of valve wing; CB: closing body; CM: covering membrane; CMI: portion of covering membrane that can become inflexed; CMR: distal recurving of covering membrane; EK: expanding keel (striped); ES: expanding sheet (stippled); P: placenta; S: seed; SP: septum; VW: valve wing.



Figures 4–6 Longitudinal section through locules; the combinations of characters shown are possible, but others can occur as well; shapes of lower parts of fruits are much more variable. **4.** Locule with covering membrane as shown in Figure 2, the inflexed portion bending down; tiny closing body. **5.** Locule with a ± straight covering membrane with a distal recurving with a closing rodlet (CR) at its base; together with the large closing body, these elements block the distal opening of the locule completely. **6.** Locule with an undulate covering membrane with a well-developed distal recurving (CMR) at the base of which a closing bulge (CBU) is developed touching the large closing body. Abbreviations as in Figures 1–3; CBU: closing bulge; CR: closing rodlet.

bodies block the distal exit of the locule completely (Figures 3, 5 & 6), small ones (Figure 2) are often inconspicuous. Other additional closing devices are produced from the distal end of the covering membranes (CM, CMI in Figures 2–6). Closing rodlets are rodlet-shaped (CR in Figure 5) and therefore restricted in lateral extension. Closing bulges (CBU in Figure 6) form a prominent mass at the base of the recurved distal end (CMR in Figures 3, 5 & 6) of well-developed covering membranes with a considerable lateral extension. Closing ledges are tangential pleats extending laterally like bulges but much more distinctly limited; they disintegrate with age while bulges and rodlets persist longer.

Key to the two subfamilies

1. Nectaries in flowers koilomorphic, i.e. shell-shaped, and always separate; ovary always with an axile placenta; fruits with expanding keels of purely septal origin reaching from the central columella to the tip of the valve; if not hygrochastic, i.e. capsules open repeatedly when moistened and close again when dried, a woody nut ..... ***Mesembryanthemoideae***
- Nectaries in flowers lophomorphic, i.e. crest-shaped, either as separate glands or united into a ring, rarely flatter and inconspicuous, very rarely absent; ovary with parietal to basal placentation, very rarely in a few species axile; fruits with expanding keels mostly of valvar origin with only a small septal portion near the outer rim of the locule, and never reaching to the centre of the fruit; if not hygrochastic, xerochastic, i.e. capsules open through a drying process, or breaking into mericarps ..... ***Ruschioideae***

See keys to Ruschioideae further on.

Key to the genera of the subfamily Mesembryanthemoideae

1. Plants compact, internodes completely enclosed by the leaves and invisible; leaves fat-digitiform, big (length up to 100 mm, diameter up to 20 mm), alternate ..... ***Dactylopsis***

– Plants shrubby, herbaceous or straggling; leaves flat or cylindrical, if the latter, much smaller than above .....
2. Leaves opposite and basally free, but with tubular sheaths, enclosing one another; seeds large (up to 2 mm long); flowers solitary and large, up to 45 mm in diameter ..... ***Aspazoma***
– Leaves alternate, if opposite, not free and without sheaths clasping one another; seeds smaller (well below 2 mm long); flowers in dichasia, if solitary, smaller than above **3**
3. Plants with articulate assimilating stems with a persistent succulent primary cortex **4**
– Plants with a continuous stem, only the youngest stages green, primary cortex not persistent **7**
4. Seeds 1.3–1.5 mm long ..... ***Aptenia***
– Seeds small, 0.6–1.3 mm long (if longer, enclosed in a nut) **5**
5. Stems and leaves with similar, ± reduced bladder cells; seeds less than 1 mm long; placenta protruding between the bases of the expanding keels; inner staminodes scarious ..... ***Psilocaulon***
– Stems with densely arranged xeromorphic bladder cells, i.e. firm to the touch and do not changing their shape noticeably when dried, leaves with distant ± mesomorphic ones, i.e. soft to the touch; seeds 1.0–1.5 mm long; placenta not dividing the expanding keels, or expanding tissue absent; inner staminodes not scarious **6**
6. Fruit a woody nut, seeds not visible ..... ***Pseudobrownanthus***
– Fruit a hygrochastic capsule; seeds small, ⩽ 1 mm long ..... ***Brownanthus***
7. Seeds small, 0.5–1 mm long; plants annual or somewhat longer-lived **8**
– Seeds medium to large, 1.2–2 mm long; plants perennial subshrubs ..... ***Phyllobolus***
8. Leaves only opposite, basal ones united broadly into a funnel or tube, epidermis with finely pleated cuticle ..... ***Synaptophyllum***
– Leaves alternate or if opposite, never united into a dish or tube, but possibly connate, epidermis with a smooth cuticle ..... ***Mesembryanthemum***

Keys to the genera of the subfamily Ruschioideae

1. Key to the genera based primarily on characters of the fruit and flower

1. Fruit and indehiscent, fleshy berry ..... ***Carpobrotus***
– Fruit dry **2**
2. Fruit a nut, finally disintegrating into nutlets, or breaking into mericarps **3**
– Fruit a loculicidal capsule **5**
3. Fruit woody, dispersal unit a nut or nutlets **4**
– Fruit leathery, breaking into one-seeded mericarps as dispersal units ..... ***Hymenogyne***
4. Fruit > 10 mm in diameter, finally breaking completely into mericarps; leaves flat ..... ***Caryotophora***
– Fruit < 7 mm in diameter; the sclerotinized vascular bundles of the fruit remaining on the plant; leaves ± club-shaped to falcate ..... ***Ruschianthemum***
5. Capsule xerochastic, expanding tissue absent **6**
– Capsule hygrochastic, expanding tissue present **8**
6. Locules 5–7 ..... **7**
– Locules > 8 ..... ***Conicosia***
7. Fruit with basal portion flat and formed like a ring-shaped pocket, containing the seeds, septa remaining adnate to the valves ..... ***Saphesia***
– Fruit with separate seed-pockets at half the height of the capsule, septa free from valves ..... ***Skiatophytum***
8. Expanding tissue reduced, consisting of either expanding sheets or expanding keels **9**
– Expanding tissue consisting of both, expanding sheets and keels **12**
9. Expanding keels only **10**
– Expanding sheets only **11**
10. Locules open, seeds visible in seed pockets at outer base of locules; pedicel glabrous; leaf margin with bladder cells only ..... ***Apatesia***
– Locules covered by septa converging over them, seeds hidden, placenta raised, but without seed pockets; pedicel and calyx with long hairs; leaf margin with long hairs ..... ***Carpanthea***
11. Leaves lyrate ..... ***Aethephyllum***
– Leaves entire ..... ***Dorotheanthus***
12. Capsule opening but once, rarely again, but never repeatedly, expanding keels breaking after first opening **13**
– Capsule opening repeatedly (capsules should still be functional, not too old), expanding keels remaining functional **14**
13. Locules 5 or 6, valves free to base; valve wings broad, hard, erect; seeds wind-dispersed ..... ***Stoeberia***
– Locules (4–6)–12, valves united laterally at base, valve wings absent; seeds rain-dispersed **107**
14. Covering membranes present **15**
– Covering membranes absent (sometimes narrow rims) ... **16**
15. Covering membranes of constant shape, even after the seeds have been removed **46**
– Covering membranes declining into empty locules (see CMI in Figures 2 & 4) **47**
16. Expanding keels distinctly differentiated from expanding sheets, keels parallel, high, ± sharply pleated **19**
– Expanding keels merging into expanding sheets (if keels are very low, see 11), widely diverging **17**
17. Heterophyllous shrubs, i.e. leaves of different nodes differ in shape (often in size also), but those of a pair are equal ..... ***Mitrophyllum***
– Homophyllous plants, i.e. all leaves on a plant are more or less equal **18**
18. Annual herbs ..... ***Cleretum***
– Perennial plants ..... ***Delosperma***
19. Calyx and leaves sticky, sand adhering to it ..... ***Psammophora***
– Calyx and leaves not sticky **20**
20. Valve wings absent or as awns **21**
– Valve wings present, ± rectangular **24**
21. Capsule opening incompletely (valves at most erect); leaves ± club-shaped with apical windows ..... ***Frithia***
– Capsules opening completely (valves spreading); leaves without apical windows **22**
22. Pedicel very long (50–120 mm), flowers mostly ternate; leaves keeled, toothed; plants compact ..... ***Carruanthus***
– Pedicel shorter (± 25 mm), flowers solitary; leaves not keeled, not toothed; plants shrubby, caespitose to decumbent or creeping **23**

23. Valves with long ribbon-shaped appendages at tips; flowers opening midday; shrubs ..... ***Jensenobotrya***
– Valves without appendages at tips; flowers opening at night; plants creeping or caespitose ..... ***Neohenricia***
24. Valve wings at most as broad as expanding keels **25**
– Valve wings broader than expanding keels **26**
25. Plants creeping ..... **Mossia**
– Plants compact or shrubby **111**
26. Bracteoles present (different from foliage leaves) **35**
– Bracteoles absent (or indistinguishable from foliage leaves) **27**
27. Base of capsule with very long soft hairs; leaves velvety-hairy ..... ***Muiria***
– Base of capsule and leaves with bladder cells, glabrous, or velvety **28**
28. Plants compact, internodes very short and enclosed, invisible **29**
– Plants ± shrubby, internodes visible ..... ***Delosperma***
29. Base of capsule and leaves with bladder cells; plants heterophyllous ..... ***Oophytum***
– Base of capsule and leaves xeromorphic, glabrous or velvety; plants homophyllous **30**
30. Leaves obliquely triquetrous ..... ***Schwantesia***
– Leaves isometric **31**
31. Plants forming clumps above ground **32**
– Plants sunken into the ground **33**
32. Leaves with teeth at margins ..... ***Stomatium***
– Leaves without teeth ..... ***Dinteranthus***
33. Predominant number of locules per fruit in a population 5 or 6 ..... ***Lithops***
– Predominant number of locules per fruit 7 or more **34**
34. Seeds tuberculate, tubercles distant ..... ***Dinteranthus***
– Seeds smooth to rugose ..... ***Lithops***
35. Flowers in ± rich dichasia **36**
– Flowers solitary **38**
36. Complete plant representing the inflorescence; annual vegetative regeneration from base regular; leaves mesomorphic with bladder cells ..... ***Delosperma***
– Inflorescence perennial, well raised above and separated from basal vegetative clump; no annual regeneration of parts; leaves xeromorphic **37**
37. Flowers remaining open during and after anthesis, petals stiff ..... ***Nelia***
– Flowers closing overnight, petals lax ..... ***Delosperma***
38. Nectary as 5 separate glands **39**
– Nectary as a lophomorphic ring **41**
39. Flowers with a short hypanthium, leaves mostly with teeth ..... ***Stomatium***
– Flowers with free elements from above the ovary; leaves mostly without teeth **40**
40. Leaf surface fine velvety, whitish-grey ..... ***Corpuscularia***
– Leaf surface rough, granular, dark green ..... ***Rhinephyllum***
41. Locules ≤ 7 ..... **43**
– Locules ≥ 10 ..... **42**
42. Base of capsule and leaves finely papillate; pedicel persistent on fruit; plants above ground ..... ***Namibia***
– Base of capsule and leaves glabrous; capsule breaking from the pedicel and dispersed as a tumble fruit; plants at least partly sunken into the ground ..... ***Nananthus***
43. Petals and stamens united into a tube **44**
– Petals and stamens free from the base ..... ***Herreanthus***
44. Leaves warty ..... ***Berrisfordia***
– Leaves smooth or papillate **45**
45. Leaves soft, mesomorphic ..... ***Ophtalmophyllum***
– Leaves ± hard, xeromorphic ..... ***Conophytum***
46. Covering membranes thin and flexible, not distally recurved (straight) and always without any additional closing devices like rodlets, ledges or bulges at their distal ends **47**
– Covering membranes firm and resilient, but not flexible and flat, ± distinctly distally recurved, with or without additional closing devices like rodlets, ledges or bulges; if straight, always with some additional closing device **94**
47. Covering membranes declining into the empty locule along a preformed edge **85**
– Covering membranes straight or only slightly and gradually declining into empty locules **48**
48. Plants with distinct and prominent bladder-cells glistening in the sun, often appearing scaly on herbarium material **49**
– Plants glabrous or hairy, surfaces ± homocellular **65**
49. Leaves flat, petiolate; plants annual **50**
– Leaves terete to trigonous or semiglobose; plants perennial **53**
50. Leaves lyrate **51**
– Leaves entire **52**
51. Top of capsule flat, with expanding sheets only ..... ***Aethephyllum***
– Top of capsule with ribs, with expanding sheets merging into expanding keels ..... ***Cleretum***
52. Valve wings broad, rectangular ..... ***Cleretum***
– Valve wings tapering into awns ..... ***Dorotheanthus***
53. Plants heterophyllous **54**
– Plants homophyllous **59**
54. Expanding keels divergent, emerging gradually from expanding sheets **55**
– Expanding keels parallel, sheets sharply differentiated from expanding keels ..... ***Oophytum***
55. Plants compact and low (height < 40 mm) ..... ***Diplosoma***
– Plants shrubby, if compact, height > 50 mm **56**
56. Basal parts of old leaf sheaths sclerotic, completely enveloping the stem ..... ***Monilaria***
– Old leaf-sheaths papery, parchment-like **57**
57. Flowers basally enclosed by connate hypsophylls forming a cup ..... ***Dicrocaulon***
– Flowers exserted above leaves, no cups **58**
58. Both leaf pairs of a season connate for > 30% of their length ..... ***Meyerophytum***
– One leaf pair of a season connate for < 25% of its length, spreading, the other for > 50%, erect ..... ***Mitrophyllum***
59. Leaves with an apical diadem (a specialized group of spreading bristles with a corky base) ..... ***Trichodiadema***
– Leaves without an apical diadem **60**
60. Bladder cells on leaves thin-walled, collapsing when dry, surface glistening **61**
– Bladder cells thick-walled, constant in shape, surface velvety **64**
61. Surface of primary internodes with prominent bladder cells ..... ***Drosanthemum***
– Surface of primary internodes glabrous **62**
62. Leaves fat-digitiform, longer than 40 mm ..... ***Jacobsenia***
– Leaves subterete to trigonous, shorter than 30 mm **63**

63. Locules 5 ..... *Mestoklema*
– Locules ≥10 ..... *Malephora*
64. Locules ≥8 ..... *Drosanthemopsis*
– Locules 6 ..... *Drosanthemum*
65. Seeds echinate ..... *Braunsia*
– Seeds ± smooth **66**
66. Leaves hairy velvety **67**
– Leaves glabrous **69**
67. Flowers with a hypanthium ..... *Imitaria*
– Flowers with free petals and stamens **68**
68. Plants compact to caespitose ..... *Gibbaeum*
– Plants shrubby **64**
69. Leaves soft, mesomorphic **70**
– Leaves ± hard, firm, xeromorphic **72**
70. Locules 5 ..... **71**
– Locules ≥10, rarely 9 ..... *Malephora*
71. Closing bodies absent; shrubs **84**
– Closing bodies bipartite; prostrate creepers ..... *Disphyma*
72. Flowers yellow **79**
– Flowers white, pale pink, or purple **73**
73. Petals stiff **74**
– Petals lax **75**
74. Closing bodies present; covering membranes complete ..... *Polymita*
– Closing bodies absent; covering membranes incomplete ..... *Nelia*
75. Top of capsule raised; old leaves dark brown **77**
– Top of capsule flat; old leaves parchment-like, whitish **76**
76. Calyx 4-lobed ..... *Juttadinteria*
– Calyx a 5-lobed ..... *Delosperma*
77. Leaves digitiform, more than 3× as long as broad; plants caespitose ..... *Antegibbaeum*
– Leaves ± trigonous, with convex sides; plants compact/tufted **78**
78. Valve wings narrow to absent ..... *Cerochlamys*
– Valve wings broad ..... *Gibbaeum*
79. Closing bodies present, sometimes as sills **80**
– Closing bodies absent **83**
80. Leaves sharply triquetrous, acuminate ..... *Bergeranthus*
– Leaves trigonous to subterete, hunched or gibbose **81**
81. Leaves markedly oblique and asymmetric; plant compact, enclosing the short-stalked fruits ..... *Bijlia*
– Leaves symmetric; plants shrubby, if compact, fruits exserted well above the leaves **82**
82. Closing body bipartite, often resembling two plates ..... *Rhombophyllum*
– Closing body single, small ..... *Hereroa*
83. Valve wings broad (>expanding keels) ..... *Chasmatophyllum*
– Valve wings narrow or absent ..... *Hereroa*
84. Flowers solitary, ebracteolate ..... *Lampranthus*
– Flowers in many-flowered inflorescences, bracteolate **102**
85. Valve wings absent, rims of valves high ..... *Ebracteola*
– Valve wings present, at least basally very broad **86**
86. Closing bodies absent **89**
– Closing bodies present, of endocarpal origin, but very small **87**
87. Top of capsule rounded-retuse (with a central depression) ..... *Aloinopsis*
– Top of capsule flat or conical **88**
88. Base of capsule papillate; leaves papillate, toothed along margins and keel ..... *Vanheerdea*
– Base of capsule smooth; leaves smooth, not keeled but fat-digitiform, blunt, never toothed ..... *Tanquana*
89. Locules 5–7, rarely 8 ..... **90**
– Locules ≥8 in all fruits **92**
90. Locules very flat, covering membranes therefore held up by the funicles; flowers appearing after the leaf-pairs thus seemingly lateral ..... *Didymaotus*
– Locules deeper, covering membranes declining into empty locules; flowers distinctly terminal **91**
91. Calyx lobes truncate and warty, like the leaves; upper leaf surface exposed, leaves never keeled, blunt, spathulate; plants mostly sunken into the ground ..... *Titanopsis*
– Calyx lobes trigonous to pointed, smooth, like the ± deltoid, keeled, gibbose leaves; plants clumpy above ground ..... *Lapidaria*
92. Capsule whitish-grey, top ± flat or conical, base funnel-shaped; leaves broadly trigonous, grey, smooth **93**
– Capsule ± dark brown, top rounded to semiglobose, base semiglobose; leaves acuminate, dark green, with raised dots ..... *Rabiea*
93. Locules 8 ..... *Octopoma*
– Locules 10 or 11 ..... *Dracophilus*
94. Closing bodies absent **95**
– Closing bodies present, sometimes as a broad sill **114**
95. Valve wings absent to narrow (≤ width of expanding keels) **103**
– Valve wing, at least at base, much broader than expanding keels **96**
96. Valve wings rectangular **98**
– Valve wings tapering into awns towards the tip of the valve **97**
97. Capsules multilocular; plants compact ..... *Pleiospilos*
– Capsules 5-locular, if multilocular, plants shrubby ..... *Erepsia*
98. Valve wings in open capsules stiff, stretching over the locules and not moving outwards with the valves ..... *Faucaria*
– Valve wings in open capsules flexible, moving outwards with the valves **99**
99. Seeds echinate ..... *Braunsia*
– Seeds with low papillae **100**
100. Plants compact/tufted ..... *Orthopterum*
– Plants shrubby, rarely caespitose or creeping **101**
101. Plants homophyllous **102**
– Plants heterophyllous ..... *Mitrophyllum*
102. Filaments broadened and connate at base ..... *Circandra*
– Filaments filiform, free ..... *Lampranthus*
103. Leaves mesomorphic **104**
– Leaves xeromorphic **106**
104. Leaves flat, periolate; plants annual ..... *Carpanthea*
– Leaves terete to trigonous; plants perennial **105**
105. Flowers yellow ..... *Scopelogena*
– Flowers white to purple ..... *Oscularia*
106. Seeds echinate ..... *Namaquanthus*
– Seeds smooth to moderately papillate **107**
107. Surface of ovary of the flower (not fruit!) concave, forming a hypanthium ..... *Erepsia*
– Surface of ovary flat to raised **108**

108. Leaves basally connate into a sheath, which is continuous with the cortex of the preceding internode **109**
– Leaves ± free or only slightly fused **111**
109. Free parts of leaves < 10 mm long ..... ***Smicrostigma***
– Free parts of leaves more than 20 mm long **110**
110. Valves 6–9 ..... ***Zeuktophyllum***
– Valves 10 ..... ***Stayneria***
111. Plants compact to caespitose **150**
– Plants shrubby **112**
112. Low, ± creeping shrublet up to 150 mm high ..... ***Esterhuysenia***
– Higher, ± erect shrub (>300 mm high) **113**
113. Flowers very bright purple ..... ***Enarganthe***
– Flowers white to pink ..... ***Wooleya***
114. Closing bodies bipartite **115**
– Closing bodies not divided **116**
115. Closing bodies U-shaped; leaves mesomorphic; plants creeping ..... ***Disphyma***
– Closing bodies of two flat plates; leaves xeromorphic; plants compact to shrubby ..... ***Rhombophyllum***
116. Leaves soft, mesomorphic, with bladder cells **117**
– Leaves hard, xeromorphic **120**
117. Plants annual, leaves flat ..... ***Dorotheanthus***
– Plants perennial **118**
118. Covering membranes straight **119**
– Covering membranes undulate ..... ***Glottiphyllum***
119. Plants heterophyllous ..... ***Mitrophyllum***
– Plants homophyllous ..... ***Drosanthemum***
120. Expanding keel clearly demarcated from expanding sheet **121**
– Expanding keel merging into expanding sheet ..... ***Bijlia***
121. Valve wings broad, i.e. broader than expanding keels (at least at base) **122**
– Valve wings absent or narrow (≤width of expanding keels) **133**
122. Valve wings rectangular, i.e. of equal width throughout **123**
– Valve wings tapering from a broad base **131**
123. Closing bodies not larger than seeds, leaving space at the sides **124**
– Closing bodies larger than seeds, blocking the distal opening of the locule **126**
124. Capsule pentamerous (5-locular) ..... ***Eberlanzia***
– Capsule multilocular **125**
125. Capsules dispersed as tumble-fruits; leaves with apical window; plants completely sunken into the ground ..... ***Fenestraria***
– Capsules persistent on pedicels; leaves fusiform and without a window; plants above ground ..... ***Jordaaniella***
126. Leaves with a sticky surface ..... ***Arenifera***
– Leaves without a sticky surface **127**
127. Base of capsule velvety or rough from papillae ..... ***Cheiridopsis***
– Base of capsule glabrous **128**
128. First leaves of side branches connate for > 50% of length ..... ***Vanzijlia***
– All leaves of side branches hardly connate (seedlings occasionally with connate leaf pairs, though) **129**
129. Capsules with closing bulges on covering membranes ..... ***Cephalophyllum***
– Capsules with closing rodlets on covering membranes **130**
130. Top of capsule turret-shaped; procumbent branches from compact centre, not rooting ..... ***Hallianthus***
– Top of capsule rounded, but not turret-shaped; erect to ascending, or saltatory, rooting plants ..... ***Leipoldtia***
131. Flowers white ..... ***Polymita***
– Flowers yellow **132**
132. Leaves sharply triquetrous, grey ..... ***Machairophyllum***
– Leaves trigonous to semi-ovate, gibbose, dark green ..... ***Pleiospilos***
133. Closing body large, completely blocking the locule **134**
– Closing body smaller, leaving some space at the sides **139**
134. Capsules 5(–6)-locular **135**
– Capsules multilocular **136**
135. Flowers yellow ..... ***Bergeranthus***
– Flowers purple ..... ***Antimima***
136. Leaves velvety, hairy or rough **137**
– Leaves glabrous **138**
137. Leaves and base of capsule velvety ..... ***Odontophorus***
– Leaves and base of capsule rough ..... ***Cheiridopsis***
138. Flowers with a hypanthium; capsule 12–24-locular ..... ***Argyroderma***
– Flowers without a hypanthium; capsule 8-locular ..... ***Octopoma***
139. Covering membranes without additional closing devices **140**
– Covering membrances with closing rodlets, ledges or bulges **144**
140. Leaves trigonous to terete **141**
– Leaves triquetrous-acuminate **142**
141. Flowers white to cream, with ± 2 000 elements ..... ***Cylindrophyllum***
– Flowers yellow, with < 300 elements ..... ***Hereroa***
142. Flowers yellow ..... ***Machairophyllum***
– Flowers white to purple **143**
143. Petals with a darker purplish longitudinal stripe; pedicels longer than leaves; capsules 5-locular ..... ***Acrodon***
– Petals uniformly coloured, white to purple; pedicels at most as long as leaves; capsules 6–10-locular ..... ***Khadia***
144. Flowers very large, more than 80 mm in diameter with more than 2 000 elements ..... ***Cylindrophyllum***
– Flowers smaller, less than 80 mm in diameter with less than 100 elements **145**
145. Covering membranes with closing rodlet **146**
– Covering membranes with closing bulge or ledge ..... ***Schlechteranthus***
146. Rims of valves in closed dry capsule very high **147**
– Rims of valves in closed dry capsule rather low **148**
147. Seeds echinate, at least in parts ..... ***Astrida***
– Seeds smooth to papillate ..... ***Ruschia***
148. Capsules 5-locular ..... ***Ruschia***
– Capsules 6–8-locular **149**
149. Foliage leaves >50 mm long ..... ***Ottosonderia***
– Foliage leaves < 40 mm long ..... ***Octopoma***
150. Capsules dark brown, with rounded tops .... ***Antegibbaeum***
– Capsules very light brown, with a flat top .... ***Ruschianthus***

2. *Keys to the genera of Ruschioideae based mainly on vegetative characters*

Key to groups

1. Leaves with a sticky surface, sand and soil adhering to it ..... **Group A**
– Leaves with a smooth or papillate surface, often glistening, but not sticky **2**
2. Plants heterophyllous ..... **Group B**
– Plants homophyllous **3**
3. Leaves flat (wider than thick), petiolate ..... **Group C**
– Leaves three dimensional; triquetrous, trigonous, terete, not wider than thick **4**
4. Plants creeping with procumbent stems ..... **Group D**
– Plants compact, caespitose or shrubby **5**
5. Plants compact and tufted, all internodes completely concealed by the leaves ..... **Group E**
– Plants caespitose, shrubby, or if basally compact then with additional long shoots **6**
6. Plants caespitose, internodes short but visible, procumbent stems not rooting ..... **Group F**
– Plants shrubby, long shoots ascending, erect, or climbing, sometimes with a compact centre **7**
7. Shrubs without spines ..... **Group G**
– Shrubs with spines ..... **Group H**

Group A. Key to plants with sticky surfaces

1. Capsule with covering membranes, locules 8; epidermis cells of leaves undivided ..... ***Arenifera***
– Capsule without covering membranes or with narrow rims, locules 5; epidermis cells of leaves divided by secondary walls ..... ***Psammophora***

Group B. Key to heterophyllous plants

1. Leaf surface with bladder cells **2**
– Leaf surface without bladder cells, homocellular **9**
2. Plants compact, tufted **3**
– Plants shrubby **5**
3. Capsules with parallel expanding keels ..... ***Oophytum***
– Capsules with divergent expanding keels **4**
4. Plants small, less than 40 mm high ..... ***Diplosoma***
– Plants bigger, 40–150 mm high ..... ***Monilaria***
5. Old leaf sheaths with selerotic bases , enclosing the internodes completely ..... ***Monilaria***
– Entire old leaf sheaths papery or parchment-like **6**
6. More than 2 leaf-pairs produced per season .... ***Dicrocaulon***
– Two leaf pairs produced per season **7**
7. Flowers basally enclosed by a cup ..... ***Dicrocaulon***
– Flower exserted above the leaves, without a basal cup **8**
8. Both leaf pairs connate for more than 50% of their length ..... ***Meyerophytum***
– One leaf pair connate for less than 25% of its length, spreading; the other connate for more than 50% of its length, erect ..... ***Mitrophyllum***
9. Capsules multilocular **10**
– Capsules 5-locular ..... ***Antimima***
10. Plants with long erect or straggling branches from a compact (tufted) base ..... ***Vanzijlia***
– Plants compact to caespitose ..... ***Cheiridopsis*** **(subg. *Cheiridopsis*)**

Group C. Key to plants with ± flat leaves (leaves wider than thick)

1. Plants annual **9**
– Plants perennial **2**
2. Leaves soft and smooth, surface mesomorphic **3**
– Leaves hard, with warts or white dots, leaf surface xeromorphic **7**
3. Fruit woody, finally disintegrating into nutlets ..... ***Caryotophora***
– Fruit a capsule **4**
4. Capsule xerochastic **5**
– Capsule hygrochastic with well-developed expanding keels and sheets **6**
5. Leaves homocellular, without bladder cells; capsules with separate marginal seed-packets at half their height ..... ***Skiatophytum***
– Leaves with bladder cells; capsule without pockets ..... ***Saphesia***
6. Plants anisophyllous, i.e. the leaves of a pair are unequal in size; capsules multilocular, with firm, undulating covering membranes, without or with reduced valve wings ..... ***Glottiphyllum***
– Plants isophyllous, i.e. the leaves of a pair are equal in size; capsules 5-locular without covering membranes, but with broad rectangular valve wings ..... ***Delosperma***
7. Leaves with warts, particularly along the distal broadened margin, leaf tip broadly rounded **8**
– Leaves with fine white, often raised dots, tip tapering ..... ***Nananthus***
8. Fruits 5-locular ..... ***Titanopsis***
– Fruit multilocular ..... ***Aloinopsis***
9. Leaf surface with prominent bladder cells **12**
– Leaf surface ± smooth **10**
10. Leaf margin ciliate; capsules with locules covered by the overarching covering membranes ..... ***Carpanthea***
– Leaf margin with bladder cells, never ciliate; capsules with seed pockets **11**
11. Leaf epidermis with tanniniferous idioblasts: fruit breaking into mericarps enclosing one seed each .....***Hymenogyne***
– Leaf epidermis without tanniniferous idioblasts: fruit opening hygroscopically by expanding keels .....***Apatesia***
12. Leaves lyrate **13**
– Leaves entire **14**
13. Top of capsule flat; valves with expanding sheets only ..... ***Aethephyllum***
– Top of capsule with ribs, valves with expanding keels merging into expanding sheets ..... ***Cleretum***
14. Valve wings broad, rectangular ..... ***Cleretum***
– Valve wings tapering into awns ..... ***Dorotheanthus***

Group D. Key to genera with creeping growth form

These plants grow procumbent and root at the nodes, only short, mainly tufted-leaved branches grow erect.

1. Internodes on main stems long, woody or spongy; adventitious roots fibrous **2**
– Internodes on main stem short, forming a fleshy corm; adventitious roots thickened and fleshy **13**
2. Internodes with prominent hairs (elongated bladder cells) ..... ***Drosanthemum***
– Internodes with papillate or smooth surface **3**

3. Fruit a berry ..... ***Carpobrotus***
– Fruit a hygrochastic capsule 4
4. Leaf surface mesomorphic, leaves soft 5
– Leaf surface xeromorphic, leaves firm 8
5. Capsule multilocular ..... ***Malephora***
– Capsule 5–6-locular 6
6. Capsule with parallel expanding keels ..... ***Delosperma***
– Capsule with diverging expanding keels 7
7. Closing bodies large, bipartite ..... ***Disphyma***
– Closing bodies absent, locule closed by funicles ..... ***Lampranthus***
8. Leaves with teeth along margin and keel ..... ***Chasmatophyllum***
– Leaves without teeth at margin or keel (but mucronate) 9
9. Capsules multilocular 10
– Capsules usually 5- or 6-locular 12
10. Capsules with small closing bodies ..... ***Jordaaniella***
– Capsules with large closing bodies 11
11. Stems strictly procumbent, each node with adventitious roots ..... ***Cephalophyllum***
– Some stems spreading, later curving down and rooting near their tips (saltatory) ..... ***Leipoldtia***
12 Leaves small, <15 mm long ..... ***Mossia***
– Leaves larger, >20mm long ..... ***Ruschia***
13. Leaves ± sharply triquetrous 14
– Leaves ± club shaped, terete with a distal widening 17
14. Capsules with >10 locules ..... ***Cephalophyllum***
– Capsules with ≤ 10 locules 15
15. Leaf margins serrate ..... ***Acrodon***
– Leaf margins entire 16
16. Flowers yellow ..... ***Bergeranthus***
– Flowers purple or white ..... ***Khadia***
17. Widened tip of leaf with a window 18
– Widened tip of leaf warty, rough ..... ***Neohenricia***
18. Capsules multilocular ..... ***Fenestraria***
– Capsules 5-locular ..... ***Frithia***

Not included are genera like *Rhinephyllum* and *Cylindrophyllum* which sometimes possess creeping forms. But the delimitation of these genera is uncertain, and consequently it is not certain whether such forms are to be included in the revised genera.

Group E. Key to genera with a compact growth form

Internodes of these plants are very short and not visible because they are enclosed by the leaf sheaths.

1. Plants isophyllous or anisophyllous, but not heterophyllous 5
– Plants heterophyllous, i.e. two different leaf pairs per season 2
2. Leaves xeromorphic ..... ***Cheiridopsis***
– Leaves mesomorphic 3
3. Fruits with parallel expanding sheets ..... ***Oophytum***
– Fruits with expanding keels widely diverging and merging gradually into expanding sheets 4
4. Plants less than 40 mm high ..... ***Diplosoma***
– Plants more than 50 mm high ..... ***Monilaria***
5. Leaves of a pair highly connate (>50%) 6
– Leaves of a pair less connate (<30%) 21
6. Plants growing sunken into the ground or in crevices 7
– Plants above ground, clumpy 13
7. Capsules >10-locular 8
– Capsules 5–8-locular 9
8. Leaf surface smooth, almost white, hard ..... ***Argyroderma***
– Leaf surface with distant papillae, bright green ..... ***Vanheerdea***
9. Fruits with basal bracteoles 12
– Fruits without basal bracteoles 10
10. Predominant number of locules per fruit in a population 5 or 6 ..... ***Lithops***
– Predominant number of locules 7 or more 11
11. Seeds tuberculate, tubercles distant ..... ***Dinteranthus***
– Seeds smooth to rugose ..... ***Lithops***
12. Leaves xeromorphic, hard ..... ***Conophytum***
– Leaves mesomorphic, soft ..... ***Opthalmophyllum***
13. Capsules with covering membranes 17
– Capsules without covering membranes 14
14. Leaf surface warty ..... ***Berrisfordia***
– Leaf surface smooth, sometimes papillate or hairy 15
15. Leaves soft, mesomorphic 16
– Leaves firm, xeromorphic ..... ***Conophytum***
16. Leaves with long hairs ..... ***Muiria***
– Leaf surface smooth, sometimes papillate ..... ***Ophthalmothyllum***
17. Leaf surface smooth, glaucous-grey ..... ***Argyroderma***
– Leaf surface with papillae 18
18. Capsules >10-locular 19
– Capsules 5–8-locular 20
19. Capsules with large closing bodies; leaves with prominent teeth along edges ..... ***Odontophorus***
– Capsules without closing bodies ..... ***Vanheerdea***
20. Flowers with a hypanthium; leaves of a pair almost completely connate into roundish bodies ..... ***Imitaria***
– Flowers with free petals and stamens, plants anisophyllous ..... ***Gibbaeum***
21. Plants with a persistent primary stem forming a head with densely arranged foliage leaves (similar to a rosette, but not flat), the inflorescences are developed laterally and mainly basally 76
– Plants without a distinct persistent primary stem and without a head as described above 22
22. Leaf surface mesomorphic, with bladder cells or smooth 23
– Leaves xeromorphic, without bladder cells, firm, smooth and papillate 25
23. Leaves anisophyllous, tongue-shaped ..... ***Glottiphyllum***
– Leaves isophyllous, ± terete or flattish 24
24. Leaf tips with a diadem (a group of spreading bristles with a corky base) ..... ***Trichodiadema***
– Leaf tips without a diadem ..... ***Delosperma***
25. Leaves with a sticky surface, sand adhering to it ..... ***Psammophora***
– Leaves not sticky 26
26. Leaves triquetrous-acuminate, i.e. tapering from the base into a pointed tip, leaves slender; developing a fleshy stem with age (corm) 27
– Leaves trigonons, hunched (= gibbose), semiglobose terete, tongue-shaped, or club-shaped but never triquetrous-acuminate as above 33
27. Plants growing sunken into the ground on loamy or silty flats, leaf tips emerging ..... ***Nananthus***
– Plants with the leaves completely above the ground, in

rocky, stony or shaly ground 28
28. At least some leaves with teeth or a serrated keel; flowers with central red stripes; fruit with a rounded base ..... ***Acrodon***
– Leaves without teeth, nor serrate 29
29 Flowers and fruits on stalked dichasia projecting beyond the leaves ..... ***Bergeranthus***
– Flowers ± solitary, not carried above the leaves 30
30. Capsule with a tiny closing body; plants with a thickened hypocotyl-rootstock 31
– Capsule with a large closing body; plants developing corms with age 32
31. Capsule with a flat or centrally raised top and a funnel-shaped base ..... ***Ebracteola***
– Capsule with a rounded top and base ..... ***Rabia***
32. Capsule > 10-locular ..... ***Cephalophyllum***
– Capsule with < 9 locules ..... ***Khadia***
33. Leaves of a pair anisophyllous 34
– Leaves of a pair isophyllous 39
34. Leaves keeled (triangular in cross section) 35
– Leaves without a keel (oval to round in cross section) 37
35. Keel sharply pleated, serrate ..... ***Cephalophyllum***
– Keel rounded 36
36. Leaves ± symmetrical and as broad as thick; capsule without closing bodies ..... ***Cerochlamys***
– Leaves asymmetrical or thicker than broad; capsule with closing bodies ..... ***Bijlia***
37. Leaf surface velvety from papillae ..... ***Gibbaeum***
– Leaf surface smooth 38
38. Leaves slender, > 3× longer than wide; capsule dark brown with a rounded top ..... ***Antegibbaeum***
– Leaves short, < 3× longer than wide; capsule greyish with a flat top ..... ***Tanquana***
39. Plants sunken into the ground 40
– Plants in clumps above the ground 46
40. Several subsequent pairs of foliage leaves on a shoot forming a rosette 41
– One pair of foliage leaves per shoot (two only during active growth or in cultivation) 44
41. Leaves small, < 8 mm wide 42
– Leaves larger, ≥ 10 mm wide 43
42. Leaves with an apical window ..... ***Frithia***
– Leaves with tiny warts, spirally arranged towards tip ..... ***Neohenricia***
43. Capsule ≥ 10-locular ..... ***Aloinopsis***
– Capsule 5–7-locular ..... ***Titanopsis***
44. Capsule 5–8-locular ..... ***Lithops***
– Capsules ≥ 10-locular 45
45. Leaves club-shaped with an apical window ..... ***Fenestraria***
– Leaves semi-globose to semi-oval, with a thick whitish surface ..... ***Argyroderma***
46. Leaves with well-developed papillae, i.e. velvety to the touch 47
– Leaves without papillae, epidermal cells sometimes elevated though, never velvety to the touch 56
47. Leaves with teeth 48
– Leaves without teeth 50
48. Capsules multilocular 49
– Capsules 5-locular ..... ***Schwantesia***
49. Capsules with a flat top and funnel-shaped bases ..... ***Cheiridopsis***
– Capsules with a rounded top and semi-globose base ..... ***Odontophorus***
50. Capsules with covering membranes 52
– Capsules without covering membranes 51
51. Leaves very thick, semi-ovate, as broad as thick; capsule multilocular ..... ***Namibia***
– Leaves triquetrous, keel prominent, capsule 5-locular ..... ***Schwantesia***
52. Capsules > 10-locular 53
– Capsules < 10-locular 55
53. Capsules with narrow valve wings ..... ***Cheiridopsis***
– Capsules with broad valve wings, at least at their base 54
54. Valve wings rectangular ..... ***Cephalophyllum***
– Valve wings tapering into an awn, pointed ..... ***Aloinopsis***
55. Covering membranes distally reflexed, firm, resilient ..... ***Antimima***
– Covering membranes straight or distally inflexed, thin, flexible ..... ***Gibbaeum***
56. Leaves without a distinct keel, although sometimes hunched (= gibbose), therefore oval to round in cross section 57
– Leaves keeled, therefore triangular in cross section 59
57. Capsules with ≥ 10 locules 58
– Capsules 5–8-locular ..... ***Cylindrophyllum***
58. Leaves semi-globose, less than twice as long as broad ..... ***Pleiospilos***
– Leaves elongate, at least 3 times as long an broad ..... ***Cephalophyllum***
59. Capsule multilocular (≥ 10) 60
– Capsules 5-8-locular 64
60. Capsules with closing bodies 61
– Capsules without closing bodies ..... ***Dracophilus***
61. Closing bodies small ..... ***Machairophyllum***
– Closing bodies large 62
62. Leaves whitish ..... ***Argyroderma***
– Leaves dark green 63
63. Capsules dark brown, ± round ..... ***Pleiospilos***
– Capsules greyish-brown, with an almost flat top ..... ***Cheiridopsis***
64. Capsules with covering membranes 65
– Capsules without covering membranes, sometimes with a rim 69
65. Leaves fat and short; flowers and fruits solitary 66
– Leaves more than three times longer than broad; flowers and fruits in dichasia 67
66. Flowers developed seemingly laterally; one leaf pair per branch ..... ***Didymaotus***
– Flowers clearly terminal; 2 or 3 leaf pairs per branch ..... ***Lapidaria***
67. Flowers white ..... ***Nelia***
– Flowers yellow 68
68. Leaves with an extensive, often emarginate hunch superseding the tip of the upper side of the leaf ..... ***Rhombophyllum***
– Leaves only moderately hunched (= gibbose) ..... ***Hereroa***
69. Valve wings absent or narrow 70
- Valve wings broader than expanding keels, rectangular 71
70. Valve wings absent, flowers white or pink ..... ***Ruschianthus***
– Valve wings narrow, flowers yellow ..... ***Carruanthus***
71. Valve wings stiff and woody, stretching over the locules ..... ***Faucaria***
– Valve wings flexible 72

72. Flowers (and fruits) with bracteoles **73**
– Flowers and fruits without bracteoles **75**
73. Leaves sharply triangular, sides straight to concave; flowers without a hypanthium **74**
– Leaves rounded-trigonous, sides concave, rarely straight; flowers with hypanthium ..... ***Stomatium***
74. Margins of leaves with teeth (sometimes few); leaves bright green ..... ***Orthopterum***
– Margins of leaves entire; leaves whitish ..... ***Herreanthus***
75. Leaves with a prominent, hard spiny tip ..... ***Schwantesia***
– Leaves with a rounded though mucronate tip ..... ***Dinteranthus***
76. Leaves xeromorphic; capsules with broad rectangular valve wings ..... ***Cephalophyllum***
– Leaves mesomorphic; capsules without valve wings or with narrow ones ..... ***Conicosia***

Group F. Key to plants with caespitose growth form

The internodes are short, the main shoots grow prostrate, adventitious roots are absent or only rarely formed.

1. Leaves mesomorphic, with or without bladder cells **2**
– Leaves xeromorphic, firm, smooth to papillate, velvety **4**
2. Leaves of a pair anisophyllous ..... ***Glottiphyllum***
– Leaves of a pair isophyllous **3**
3. Internodes smooth ..... ***Delosperma***
– Internodes with hairs derived from elongated bladder cells ..... ***Drosanthemum***
4. Leaves with apical windows **21**
– Leaves without apical windows **5**
5. Plants anisophyllous **6**
– Plants isophyllous **8**
6. Leaf surface velvety or minutely papillate ..... ***Gibbaeum***
– Leaf surface smooth **7**
7. Capsules with > 10 locules ..... ***Cephalophyllum***
– Capsules with < 10 locules ..... ***Antegibbaeum***
8. Leaves of a pair united into a fleshy body (corpuscle) ..... ***Conophytum***
– Leaves of a pair free for most of their length **9**
9. Leaves finger-shaped to terete, not keeled **10**
– Leaves trigonous to triquetrous, keeled **12**
10. Leaves small, < 6 mm in diameter, with spirally arranged warts ..... ***Neohenricia***
– Leaves larger, > 8 mm in diameter, without warts 11
11. Leaves greyish-green; capsules with a flat top; flowers with a hypanthium, number of elements < 300 ..... ***Argyroderma***
– Leaves dark green; capsules with high valve rims, top therefore elevated; flowers without a hypanthium, number of elements > 2 000 ..... ***Cylindrophyllum***
12. Leaf surface velvety-papillate **13**
– Leaf surface smooth or rough, but not papillate **14**
13. Valve wings rectangular, if pointed, plants heterophyllous ..... ***Cheiridopsis***
– Valve wings tapering into awns ..... ***Odontophorus***
14. Leaves sharply triquetrous, ± awl-shaped **20**
– Leaves trigonous **15**
15. Covering membranes absent or as narrow rims **16**
– Covering membranes complete **17**
16. Leaves with teeth along margins, rarely only horny ..... ***Stomatium***
– Leaves without teeth, surface rough from hard white tubercles, or smooth ..... ***Rhinephyllum***
17. Closing bodies small, hook-shaped ..... ***Ruschia***
– Closing bodies large or bipartite **18**
18. Covering membranes undulate with dorsal appendages ..... ***Antimima***
– Covering membranes straight, ± flat **19**
19. Leaves with an extensive, often emarginate hunch superseding the tip of the leaf ..... ***Rhombophyllum***
– Leaves not or only moderately hunched ..... ***Hereroa***
20. Flowers and fruits solitary ..... ***Khadia***
– Flowers and fruits in exserted dichasia ..... ***Bergeranthus***
21. Capsules 5-locular ..... ***Frithia***
– Capsules multilocular ..... ***Fenestraria***

Group G. Key to shrubs

These plants are perennial and possess woody, rarely succulent, persistent stems.

1. Plants with spines ..... **See Group H**
– Plants without spines **2**
2. Leaves with a sticky surface ..... **See Group A**
– Leaves smooth, rough, or velvety **3**
3. Leaves soft, with or without bladder cells **4**
– Leaves firm **16**
4. Plants heterophyllous, producing two leaf pairs per season **13**
– Plants homophyllous, producing several similar leaf pairs per season **5**
5. Internodes with prominent hairs (elongated bladder cells) ..... ***Drosanthemum***
– Internodes without prominent distant hairs **6**
6. Leaf tips with apical diadems (group of spreading bristles with a corky base) ..... ***Trichodiadema***
– Leaf tips without diadems, although sometimes with elongated bladder cells **7**
7. Covering membranes absent ..... ***Delosperma***
– Covering membranes present **8**
8. Capsules with ⩾ 10 locules ..... ***Malephora***
– Capsules with 5–8 locules **9**
9. Leaves as long and broad as a finger; flowers with a nectar ring ..... ***Jacobsenia***
– Leaves shorter, if as long as a finger, more slender, flowers with 5 separate nectaries **10**
10. Leaves broadly trigonous, glaucous grey, often dentate ..... ***Oscularia***
– Leaves terete or semi-terete, if trigonous, shorter than 20 mm **11**
11. Inflorescences distinctly differentiated from the vegetative part, very floriferous, bracteate and bracteolate **12**
– Inflorescences mostly as solitary flowers ..... ***Lampranthus***
12. Leaves terete, up to 60 mm long, apically rounded ..... ***Scopelogena***
– Leaves trigonous, up to 30 mm long, apiculate ..... ***Mestoklema***
13. Basal parts of old leaf sheaths sclerotic, completely enveloping the stem ..... ***Monilaria***
– Old leaf sheaths papery or parchment-like **14**
14. Bracteoles connote, forming a cup enclosing the base of the flower ..... ***Dicrocaulon***
– Bracteoles well below the flower **15**

15. Both leaf pairs of a season connate for > 30% of their length ..... *Meyerophytum*
– One leaf pair of a season connate for > 25% of its length, spreading, the other connate for > 50%, erect ..... *Mitrophyllum*
16. Leaves continuous with succulent, green internodes 17
– Leaves clearly distinct from the woody internodes 23
17. Fruit 5–7-locular 18
– Fruit ≥ 8-locular 19
18. Capsules without closing bodies, but with valve wings; seeds echinate ..... *Braunsia*
– Capsules with closing bodies, but without valve wings; seeds smooth or papillate ..... *Ruschia*
19. Capsules 10- or more locular 20
– Capsules 8-locular 21
20. Leaves more than 50 mm long, semi-terete, tip blunt ..... *Leipoldtia*
– Leaves less than 20 mm long, triquetrous, tip spiny ..... *Polymita*
21. Covering membranes reduced ..... *Zeuktophyllum*
– Covering membranes well developed 22
22. Valves basally connate, only tips expanding once, capsule then staying open ..... *Stayneria*
– Valve free to base, capsule opening repeatedly ..... *Smicrostigma*
23. Leaves longer than internodes dominating the aspect ('succulent shrubs') 24
– Leaves shorter than internodes, aspect dominated by woody stems ('woody shrubs') 38
24. Leaves almost globular, drupe-shaped ..... *Jensenobotrya*
– Leaves trigonous to terete 25
25. Internodes shiny, spongy ..... *Jordaaniella*
– Internodes rough from peeling bark 26
26. Foliage leaves slender, digitiform, leaves in inflorescence trigonous, much shorter ..... *Ottosonderia*
– All leaves similar 27
27. Seeds echinate 28
– Seeds glabrous or papillate 29
28. Capsules with closing body, but without valve wings ..... *Astridia*
– Capsules without closing body, but with valve wings ..... *Braunsia*
29. Capsules without covering membranes ..... *Corpuscularia*
– Capsules with covering membranes 30
30. Capsules with closing bodies 31
– Capsules without closing bodies 33
31. Capsules > 10-locular 32
– Capsules 5-locular ..... *Antimima*
32. Fruits in persistent inflorescences to which partial inflorescenses are added each season; valve wings rectangular ..... *Cephalophyllum*
– Fruits solitary or in dichasia, sometimes persistent; valve wings tapering slightly ..... *Schlechteranthus*
33. Valve wings absent 34
– Valve wings present 35
34. Flowers bright magenta ..... *Enarganthe*
– Flowers white to pink ..... *Wooleya*
35. Capsules 5-locular ..... *Hereroa*
– Capsules ≥ 8-locular 36
36. Flowers bright magenta ..... *Namaquanthus*
– Flowers white 37
37. Calyx 4-lobed ..... *Juttadinteria*
– Calyx 6–8-lobed ..... *Drosanthemopsis*
38. Capsules 5-locular (rarely up to 10 in addition) 39
– Capsules ≥ 8-locular 50
39. Fruits woody, dispersal units nutlets ..... *Ruschianthemum*
– Fruits loculicidal capsules 40
40. Capsules opening only once completely 41
– Capsules opening repeatedly 42
41. Seeds flat, dispersal by wind ..... *Stoeberia*
– Seeds roundish, dispersal by rain ..... *Erepsia*
42. Capsules with closing bodies 43
– Capsules without closing bodies 46
43. Valve wings absent ..... *Ruschia*
– Valve wings present 44
44. Closing bodies large, locules shallow ..... *Antimima*
– Closing bodies small, locules deep 45
45. Capsules breaking away from pedicels, plants therefore ± spiny ..... *Eberlanzia*
– Capsules remaining on pedicels ..... *Amphibolia*
46. Valve wings broad 47
– Valve wings absent or narrow 49
47. Leaves rough from tiny elevations ..... *Rhinephyllum*
– Leaves smooth, glabrous 48
48. Valve wings rectangular ..... *Lampranthus*
– Valve wings narrowed towards the tip ..... *Circandra*
49. Valve wings absent, expanding keels short and radial ..... *Esterhuysenia*
– Valve wings narrow (rarely broader), expanding keels longer, diverging ..... *Erepsia*
50. Plants with a compact centre and long shoots 51
– Plants without a compact renewal centre of assimilating short shoots 53
51. Long shoots procumbent only but never rooting ..... *Hallianthus*
– Long shoots erect, later leaning in other shrubs 52
52. Plants homophyllous; leaves with dentate margins ..... *Odontophorus*
– Plants heterophyllous (first leaf pair of a branch highly connate); leaves entire, mucronate ..... *Vanzijlia*
53. Capsules without closing bodies ..... *Erepsia*
– Capsules with closing bodies 54
54. Covering membranes straight ..... *Octopoma*
– Covering membranes distally recurved and undulate ..... *Leipoldtia*

Group H. Key to shrubs with spines

1. Capsules 5-locular (very rarely 4- or 6-locular) 3
– Capsules 6–9-locular 2
2. Valve wings rectangular, broader than expanding keels; more spines than fruits per infructescence; closing body large; internodes shorter than leaves ..... *Leipoldtia*
– Valve wings reduced to awns or absent; closing body medium-sized, hook-shaped; few spines per infructescence ... ... *Ruschia*
3. Closing bodies present 4
– Closing bodies absent ..... *Mestoklema*
4. Closing body large, white; covering membranes without additional closing devices ..... *Antimima*
– Closing body small, translucent to glassy; covering membranes with closing rodlets 5

5. Valve wings broad; blunt spines derived from pedicels after the ripe fruit has been shed ..... ***Eberlanzia***
– Valve wings absent or very narrow; sharp spines developed from pedicels after abortion mainly of buds or flowers ..... ***Ruschia*** **(subg. *Eberlanzia*)**

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